

# MERRA

Update for the User Group

25 August, 2006

# Overview

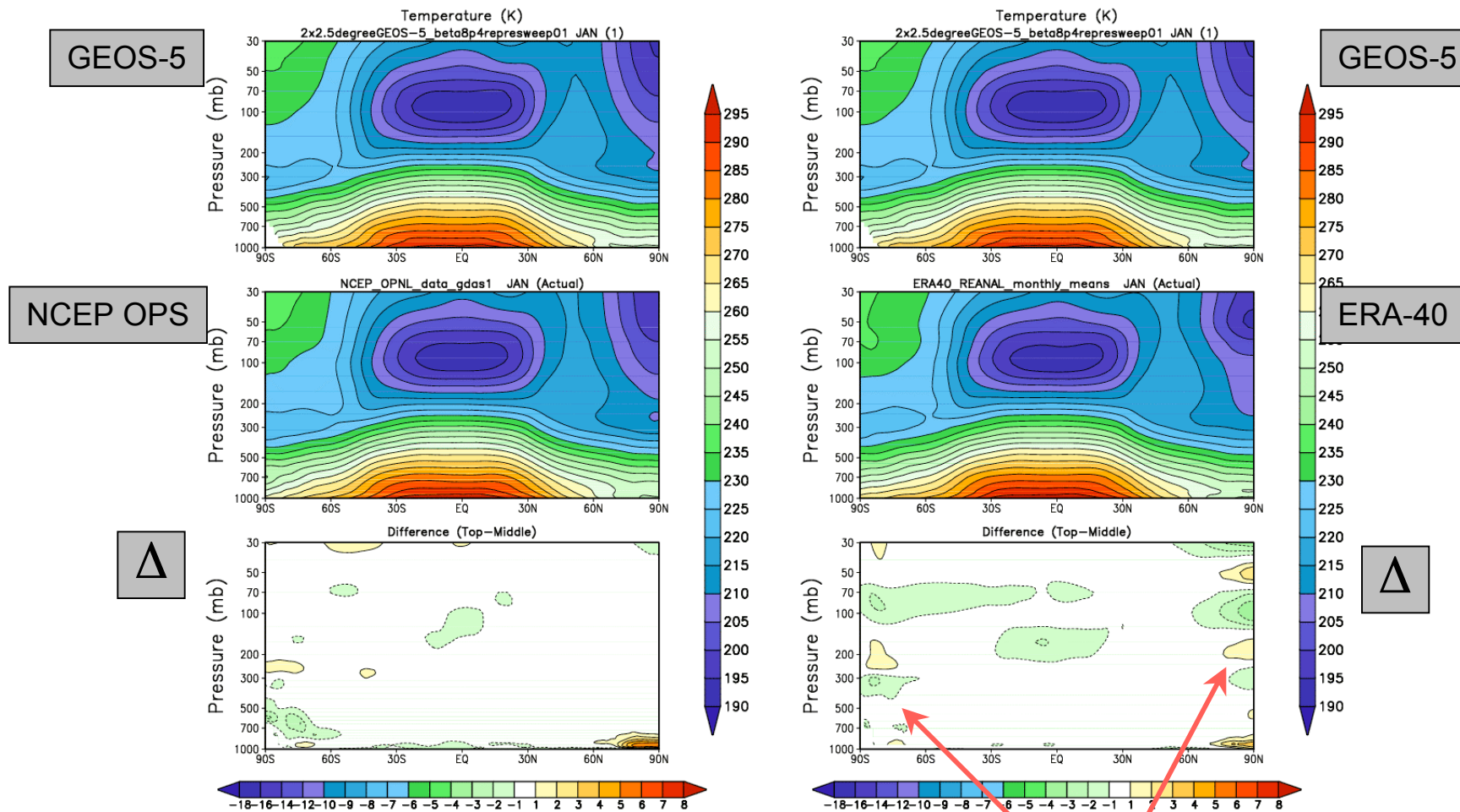
- Progress since March (last update to User Group)
- Issues we are addressing
- Schedule
- Advice sought from User Group
- Appendix (Validation strategy; Sweeper strategy; Forward processing stream strategy)

## GEOS-5 DAS Progress since March

- 1/2° eros system with IAU running in real-time parallel operations since June
- Non-science data-sweep in progress -- resolving issues with data, CRTM, QC
- 2° system used for 2001 science-quality tests -- addressing issues
  - Physics tuning in DAS model has improved moisture, precipitation and cloud fields
  - Online model bias correction through the DAS has been implemented and initial tests positive
  - Tuned background statistics and implemented balance constraint - will improve mass-wind balance
  - Implemented re-play mode for tuning model and analysis
  - Aerosols added to radiation code
- Technical improvements: single executable; improved I/O performance
- MERRA file spec has additions to operational file spec -- near finalized

## 2° MERRA tests

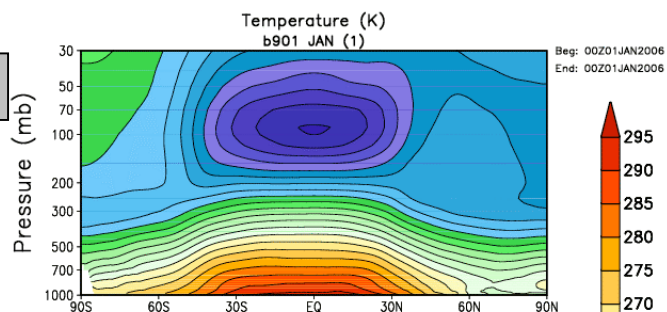
### Zonal Mean Temperature for January 2001



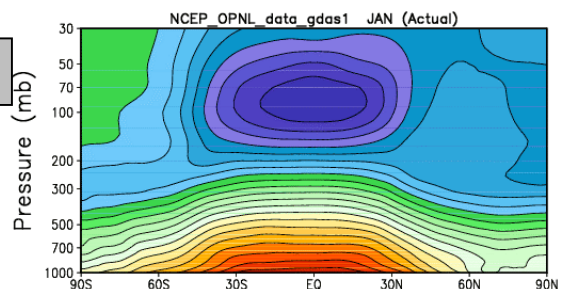
1/2° tests

## Zonal Mean Temperature for January 2006

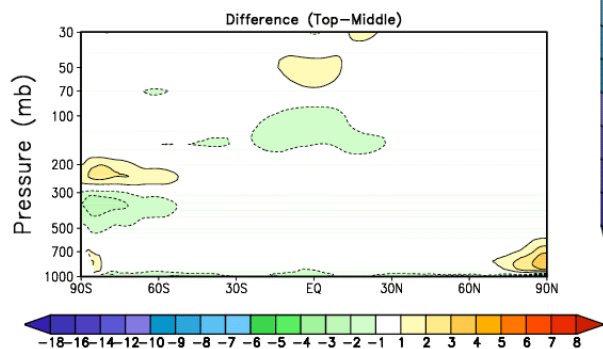
GEOS-5



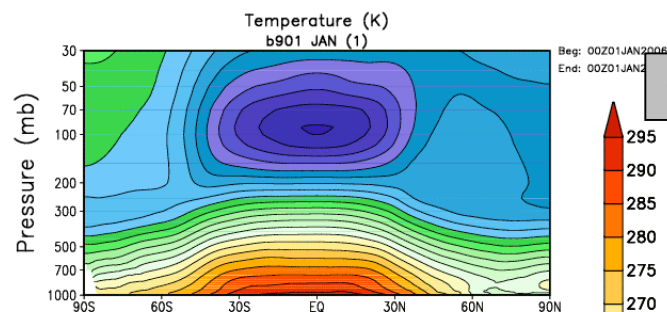
NCEP OPS



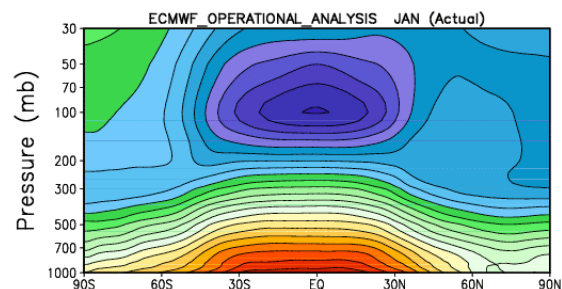
Δ



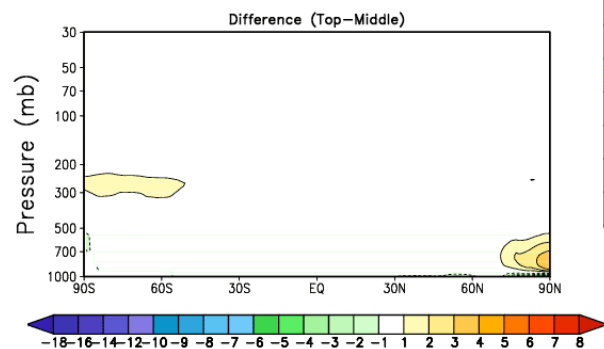
GEOS-5



ECMWF OPS



Δ



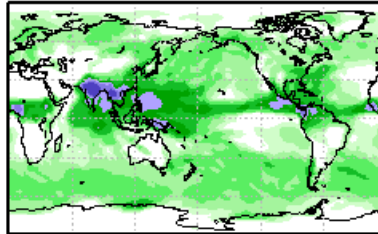
Problem corrected in operations

## 2° MERRA tests

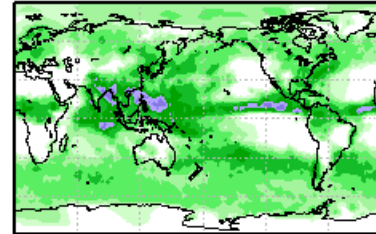
July 2001 Precipitation (mm/day)

MERRA\_old

MERRA RPSW: Mean:2.68435 Std: 3.68866

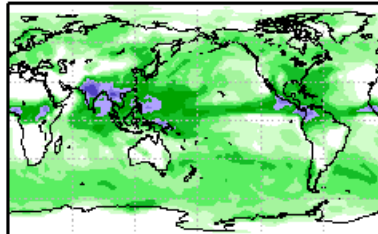


CMAP: Mean:2.77003 Std: 3.00925

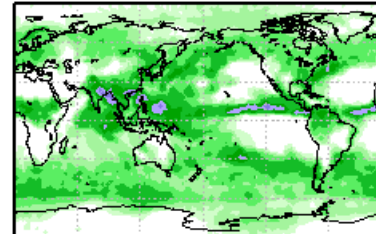


MERRA\_new

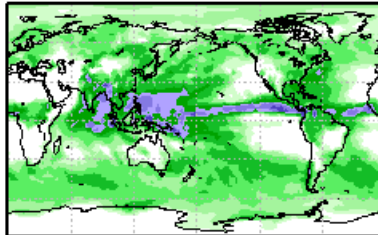
b500\_dwndft\_01: Mean:2.85346 Std: 3.39682



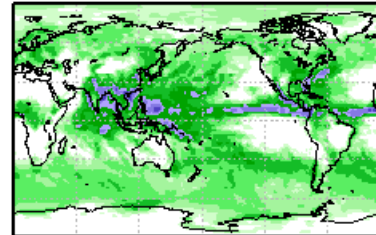
GPCP: Mean:2.66688 Std: 2.79423



ERA-40: Mean:3.49985 Std: 4.41209

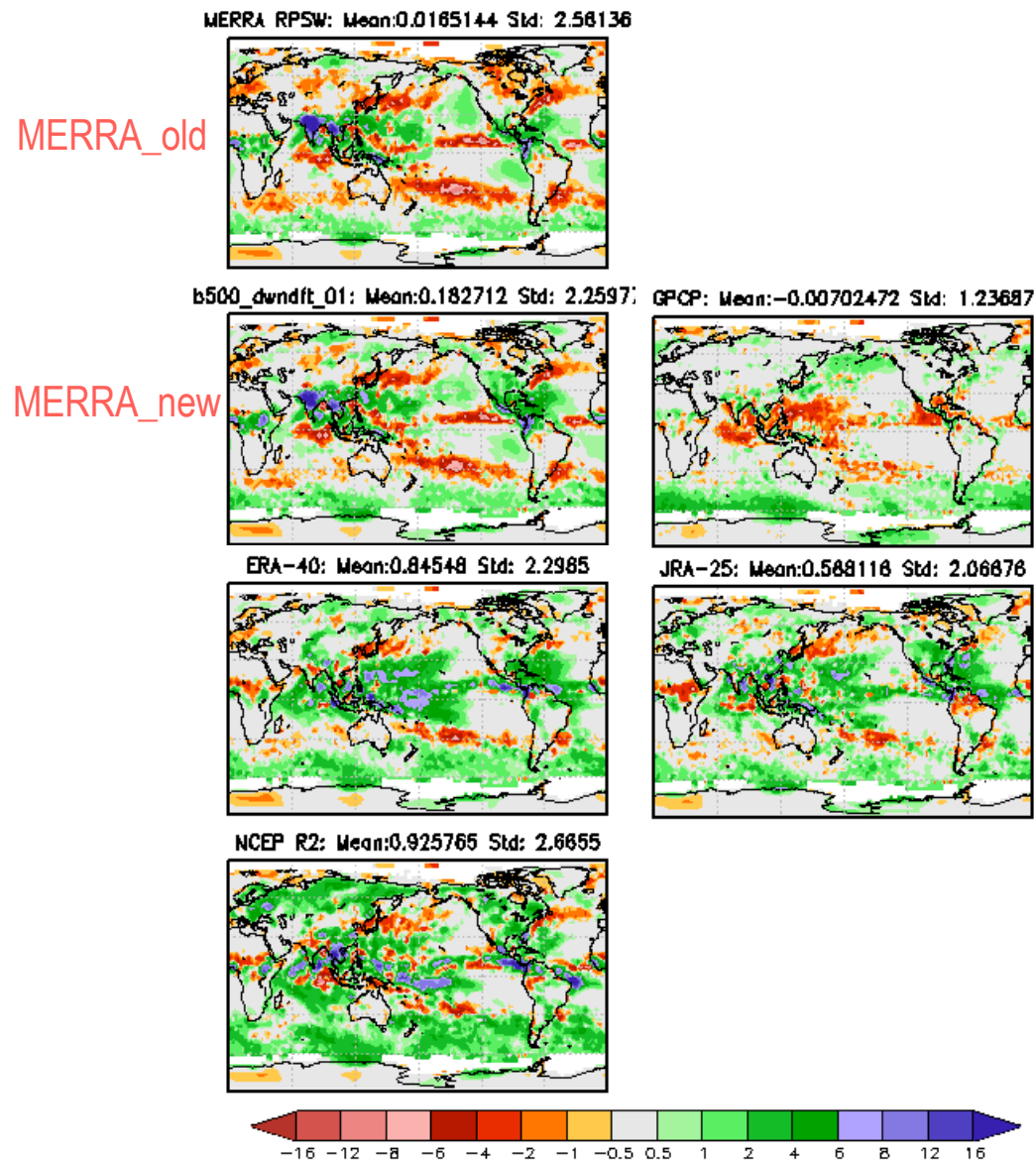


JRA-25: Mean:3.23156 Std: 3.65796



## 2° MERRA tests

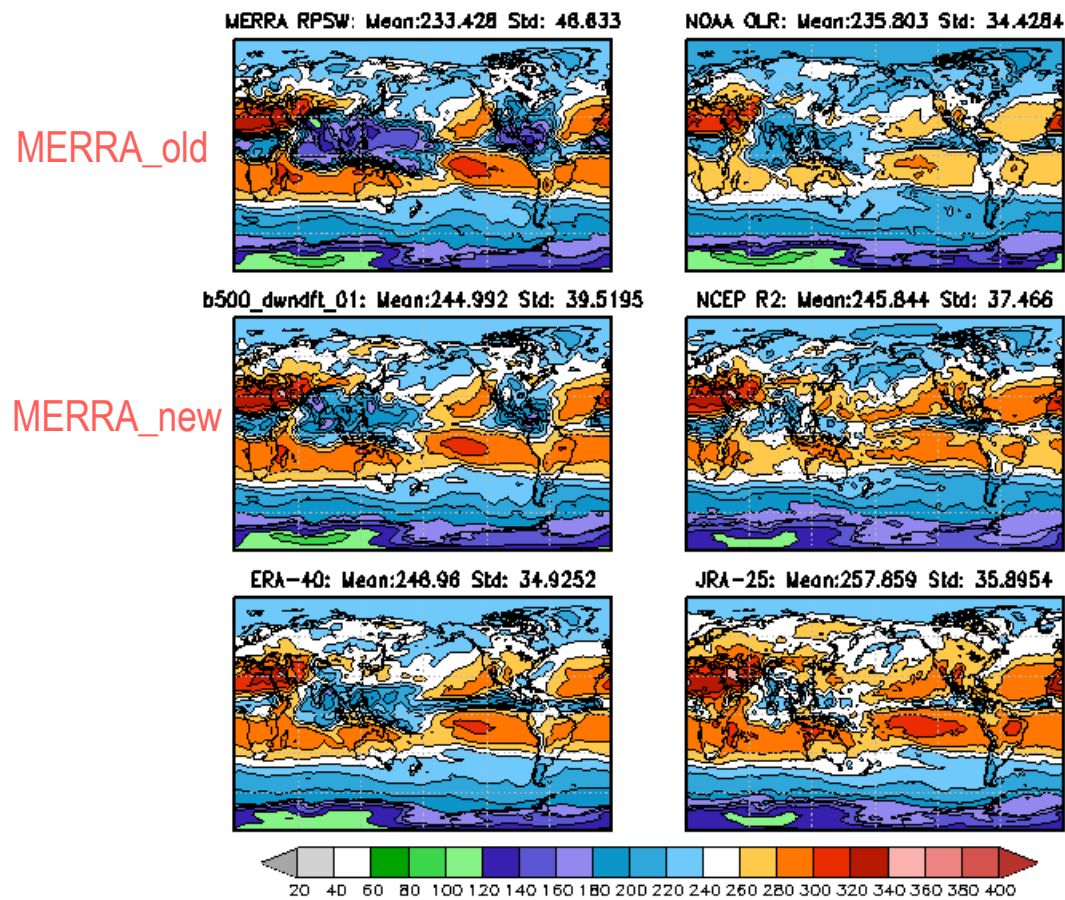
July 2001 Precipitation - CMAP (mm/day)





## 2° MERRA tests

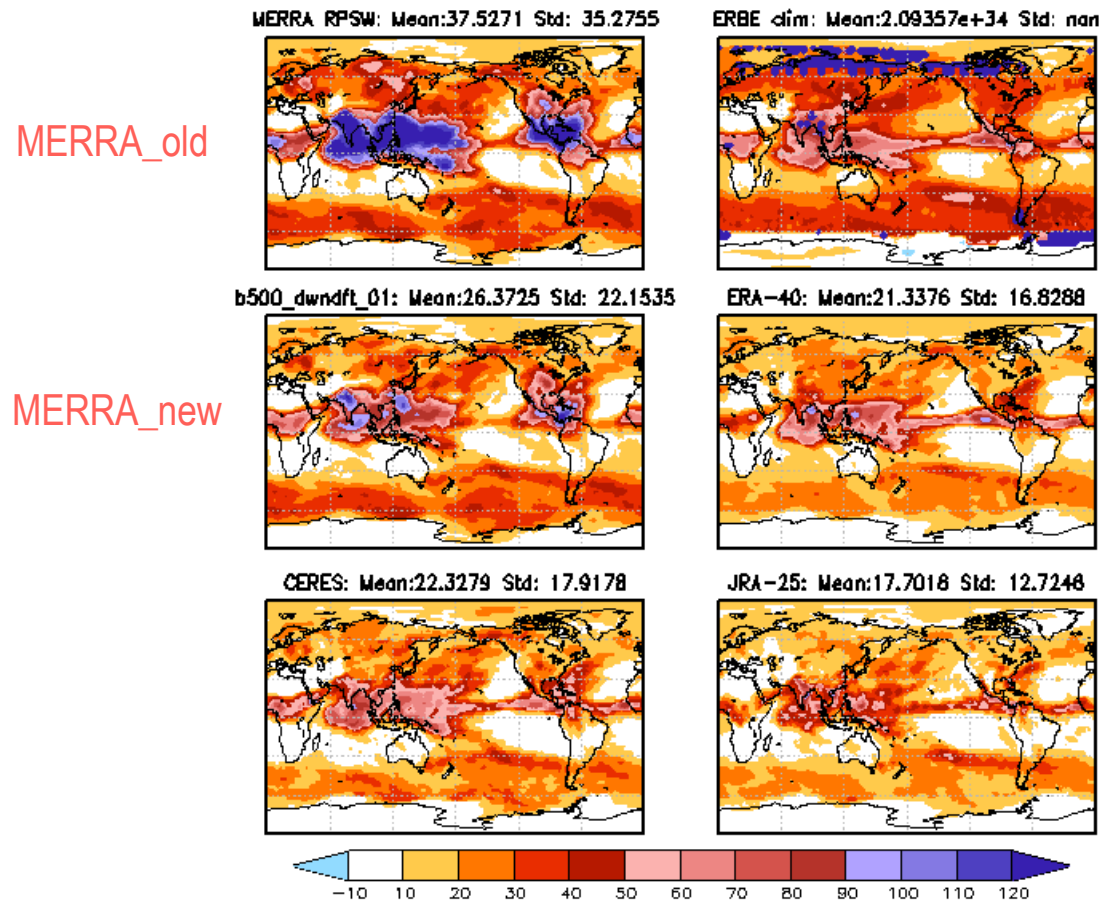
July 2001 OLR ( $\text{Wm}^{-2}$ )





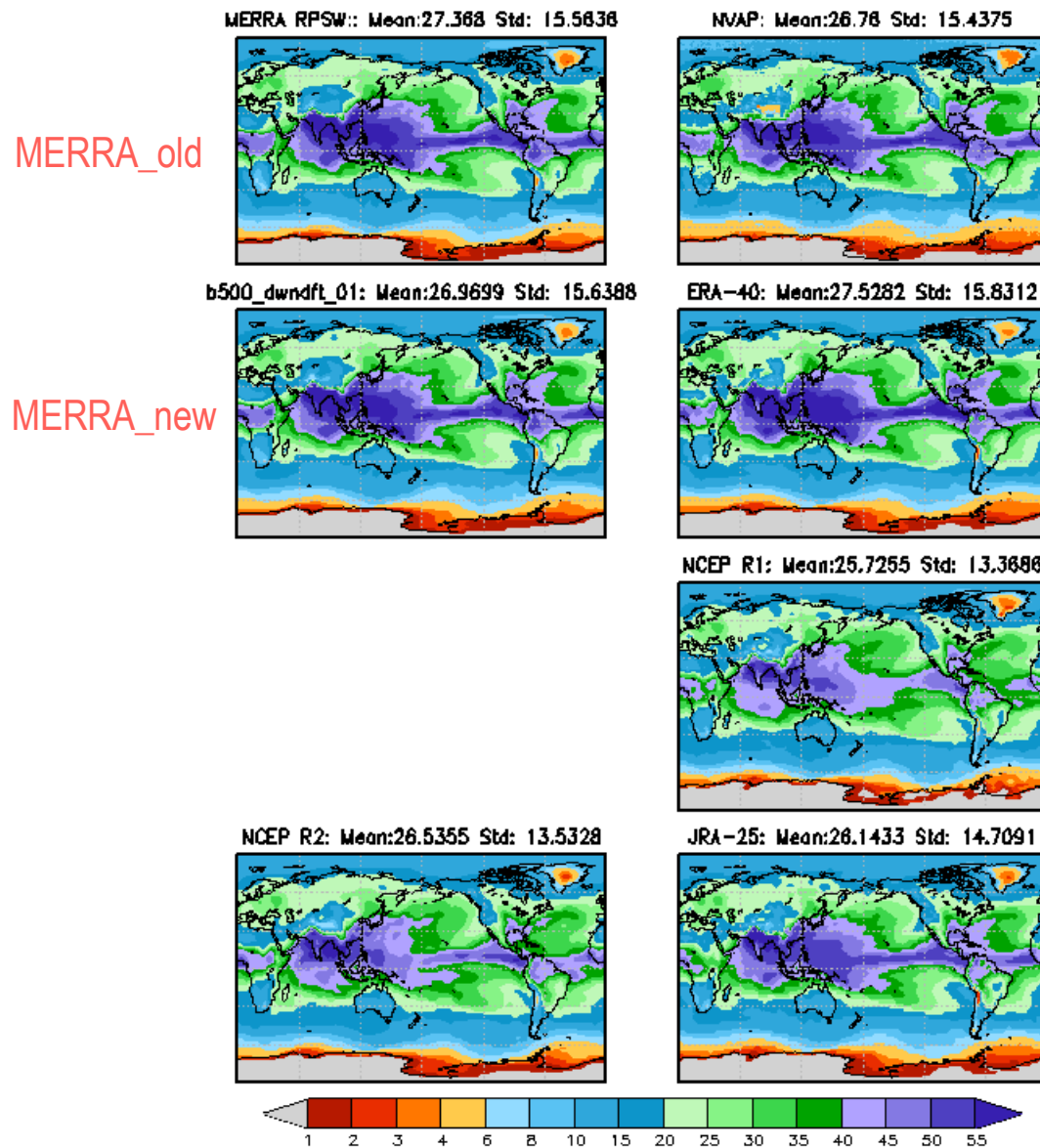
## 2° MERRA tests

July 2001 LW CRF ( $\text{Wm}^{-2}$ )



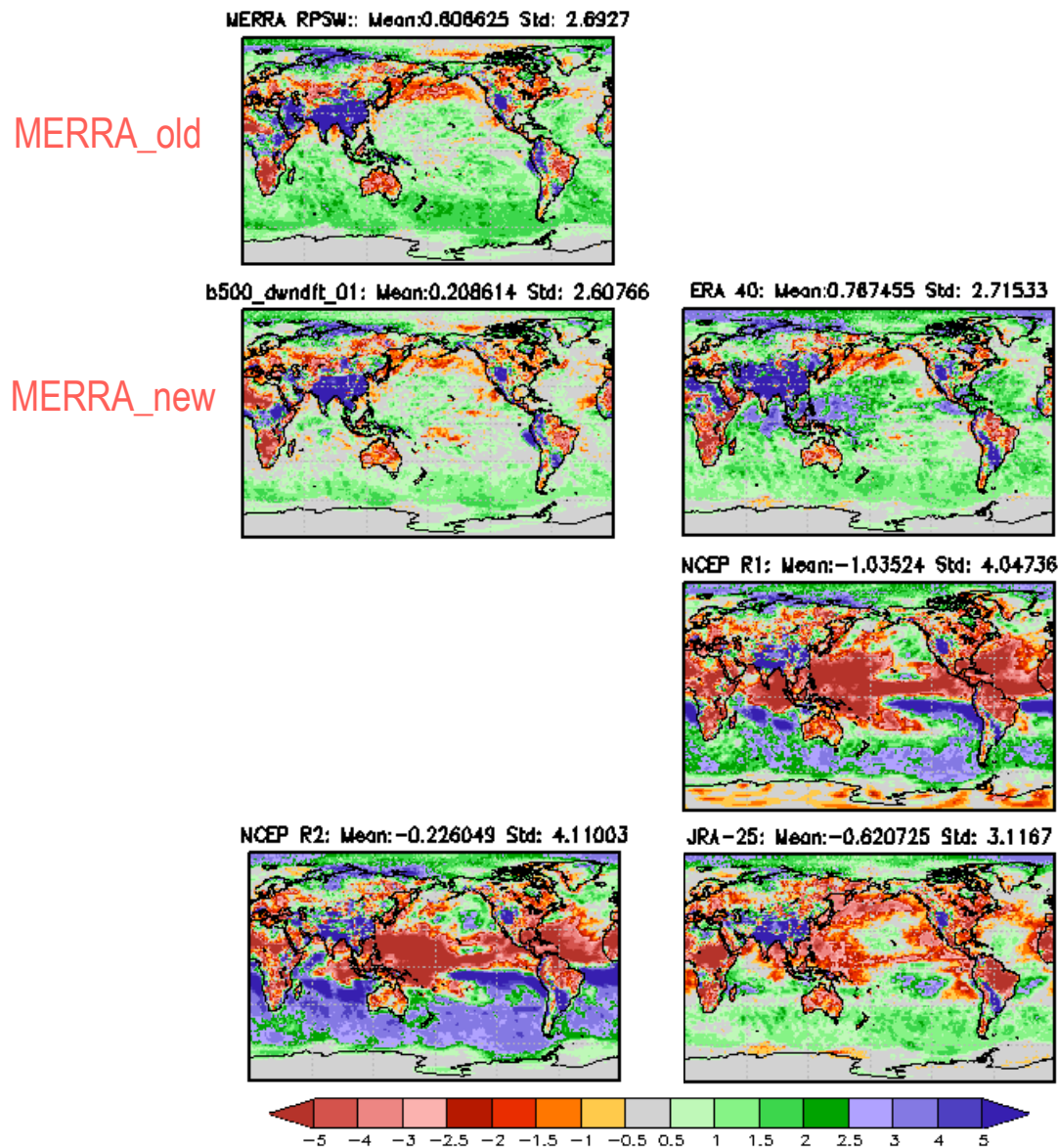
## 2° MERRA tests

July 2001 TPW (mm)



## 2° MERRA tests

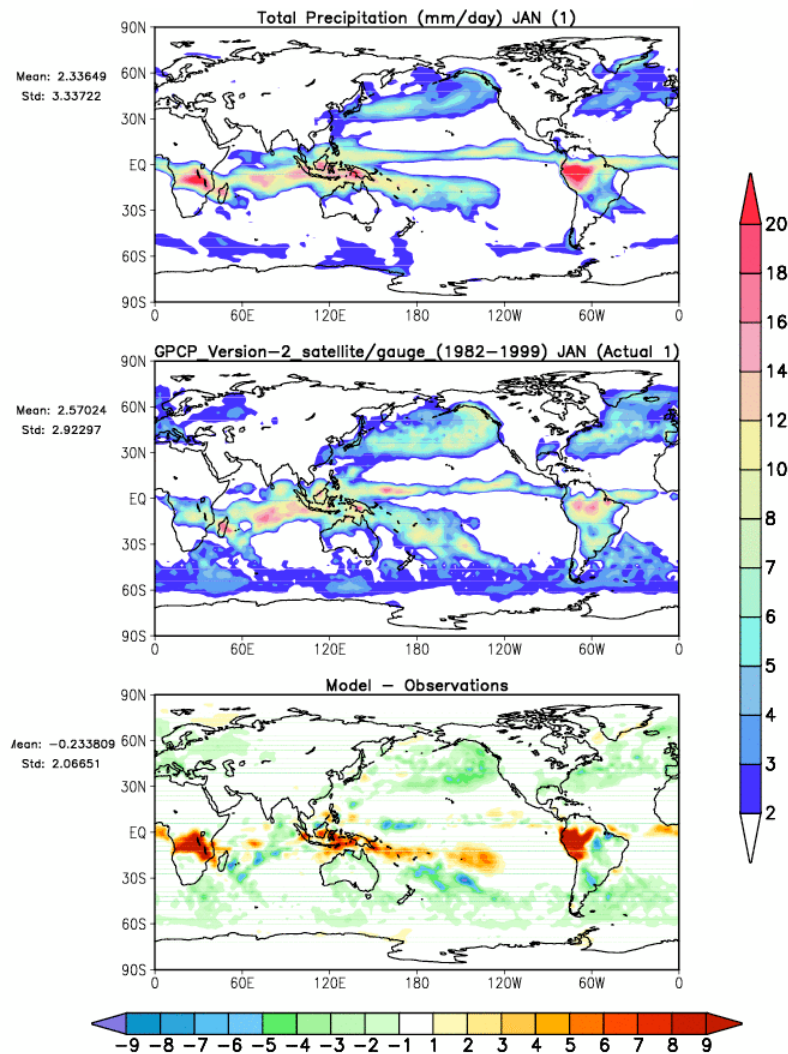
July 2001 TPW - NVAP (mm)



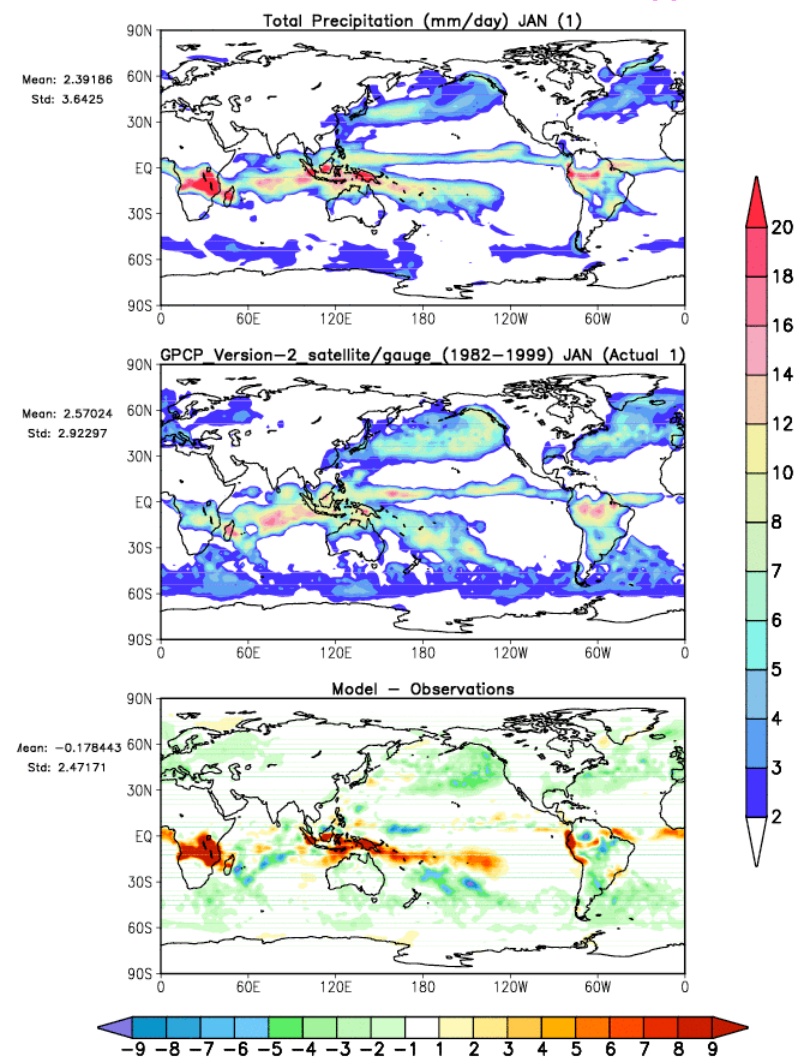
## 2° MERRA tests

### Precipitation & Online Moisture Bias Correction

#### Control - w/o online bias correction



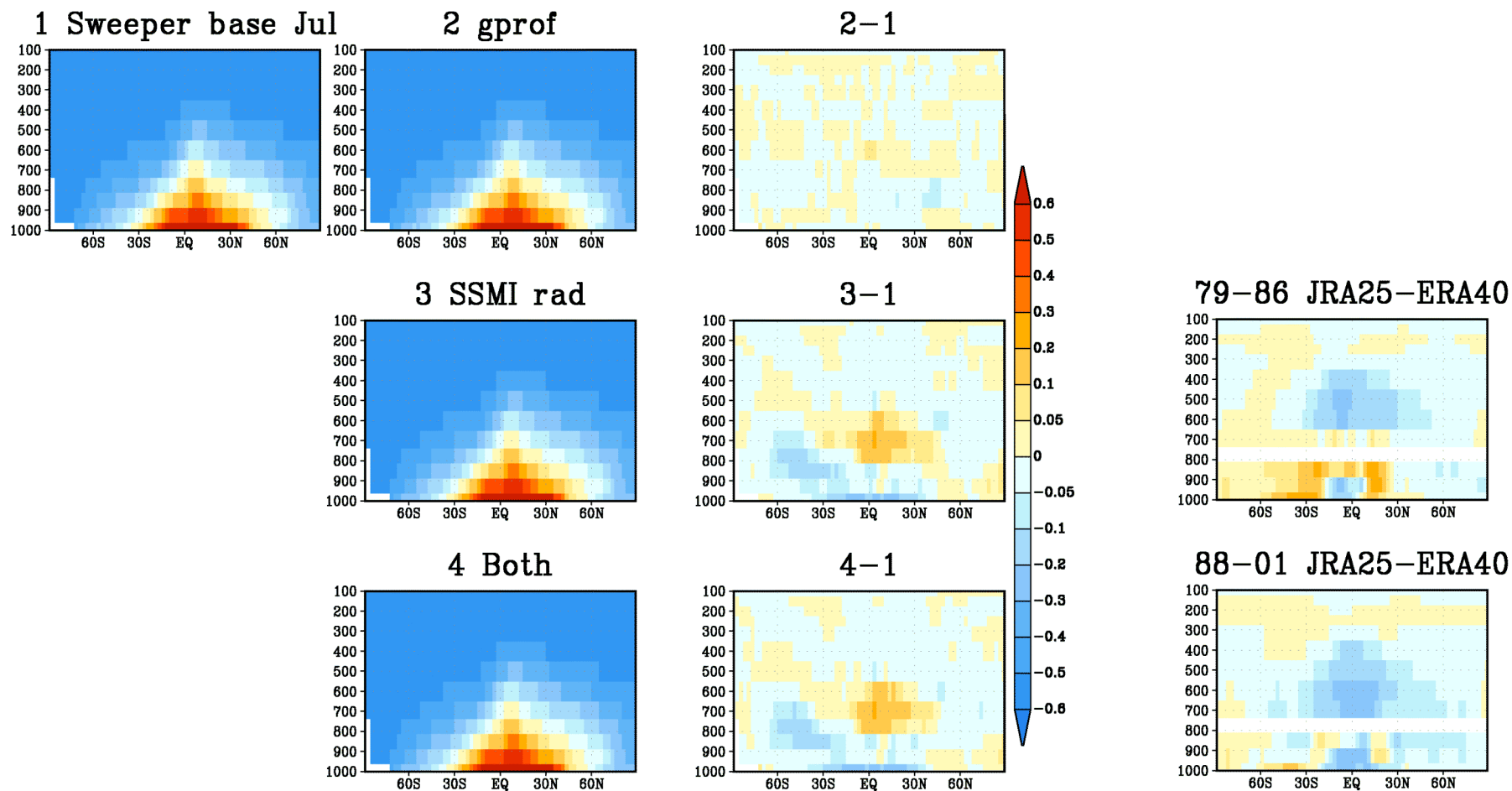
#### Online bias correction of moisture applied



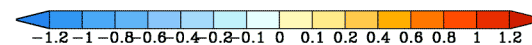


## 2° MERRA tests

### July 2001: Impact of SSMI - Zonal mean Specific Humidity

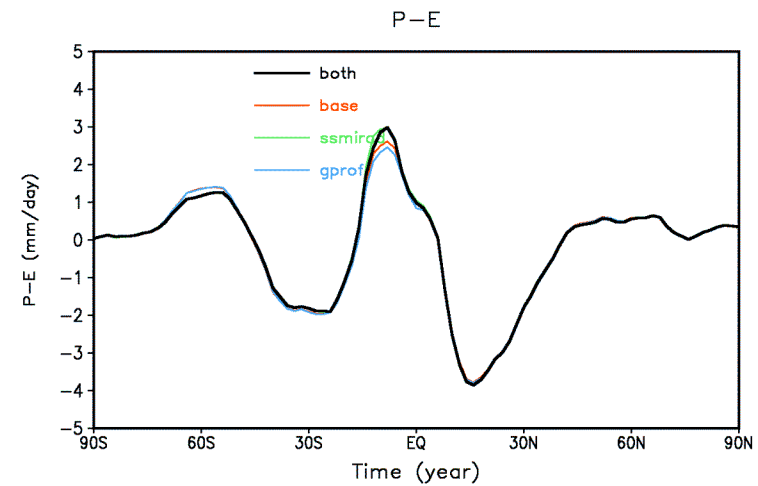
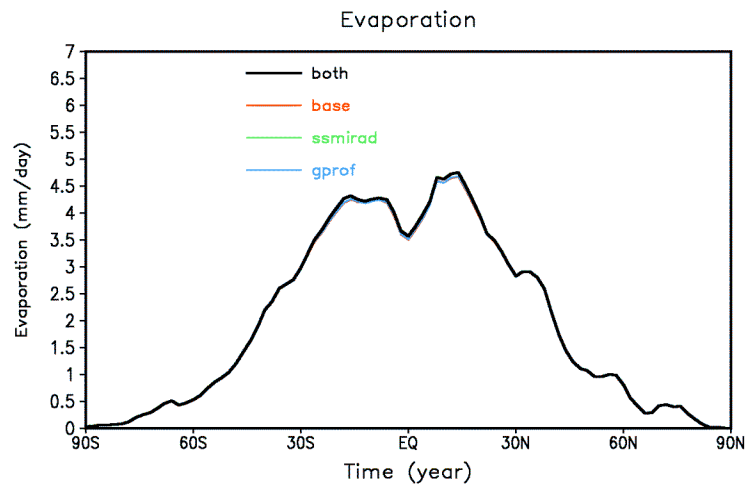
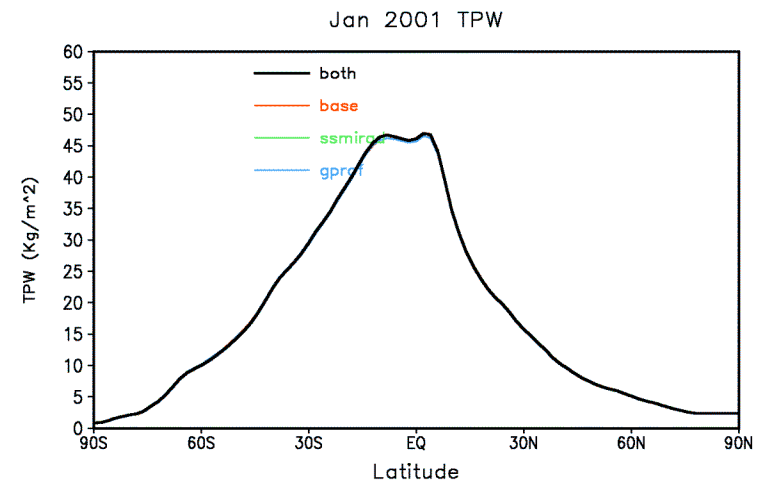
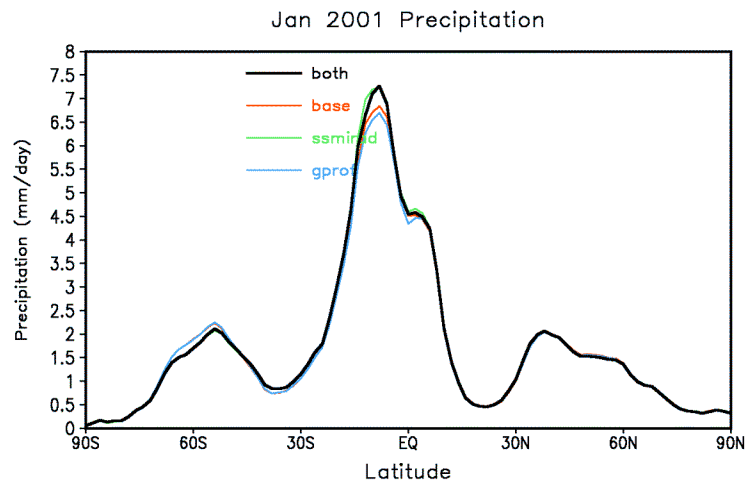


Base: No SSMI  
 GPROF: SSMI rain-rate retrievals  
 SSMI rad: SSMI radiances only

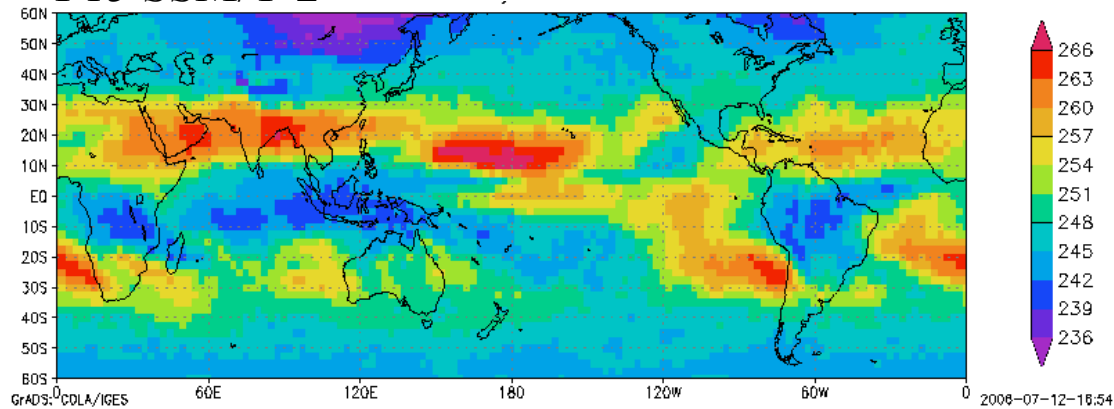


## 2° MERRA tests

### January 2001: Impact of SSMI



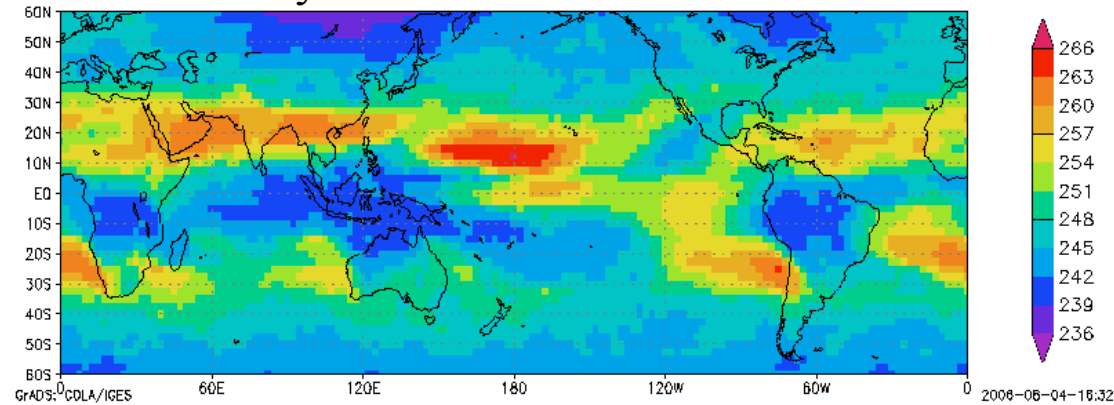
## F15 SSM/T-2



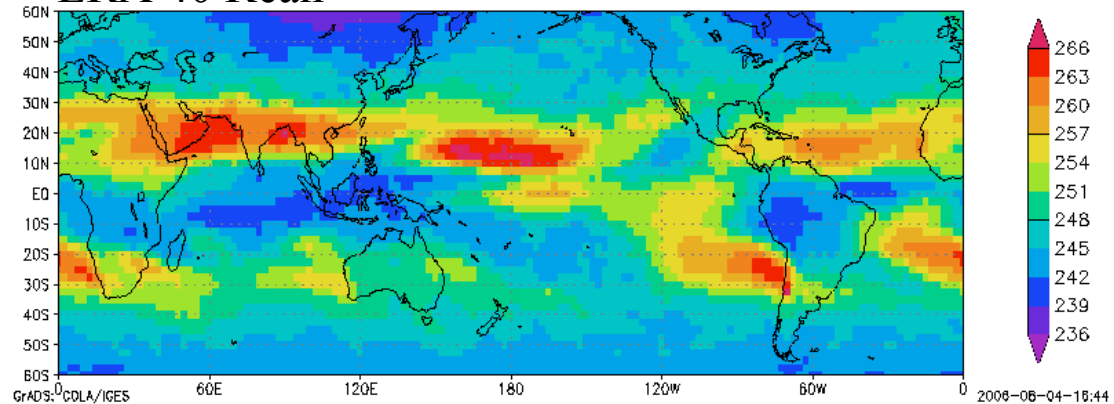
## JAN 2001 SSM/T2 Observed and Simulated 183.3 +/-1 GHz Tbs (K)

- Sensitive to moisture in  
~ 200 – 500 hPa layer
- High (low) Tbs signify  
dry (moist) regions.

## RPSW Analysis



## ERA 40 Rean



From Pete Robertson, MSFC



# MERRA

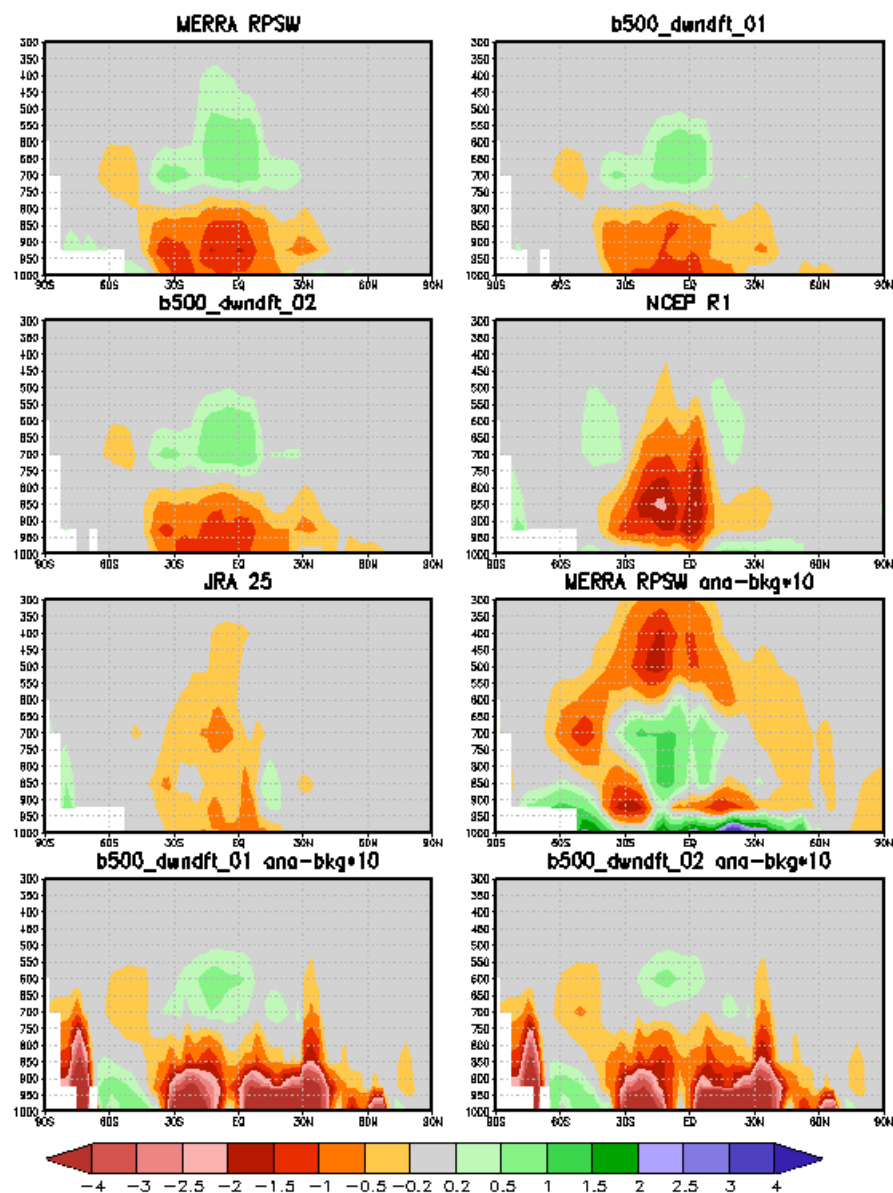
## Requirement to justify proceeding -- advance upon ERA-40

- Improved treatment of changing observing system
  - SSMI jump evident in other reanalyses has to be reduced
  - Strategy: retrospective bias correction through the model for MERRA
- Improved Hydrological cycle
  - ✓ Minor tuning remains but Tropical Precipitation and TPW already an improvement on era-40
  - ✓ Improved cloud-radiation interaction and surface/TOA radiative budgets
  - Is vertical distribution of moisture good enough?
  - Can we use precipitation data more effectively?
- Surface
  - Surface temperature has warm bias (currently no surface analysis)
- ✓ Improved stratospheric analysis
  - ✓ fully resolved middle atmosphere - an advance on era-40
  - ✓ fully interactive ozone - an advance on era-40
  - ✓ stratospheric transport less noisy than era-40

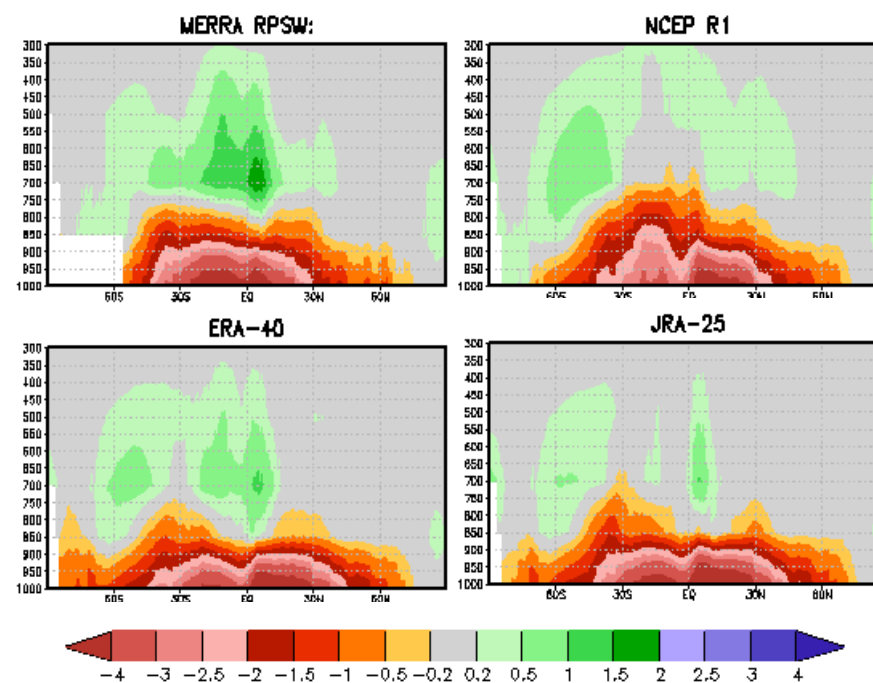
## 2° MERRA tests

### January 2001 Specific Humidity (g/kg)

Jan. 2001 Specific Humidity – ERA40 (g/kg)

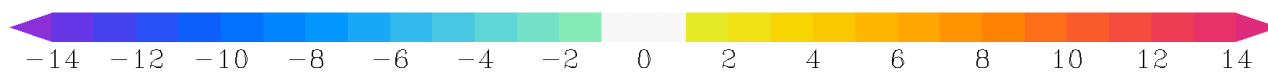
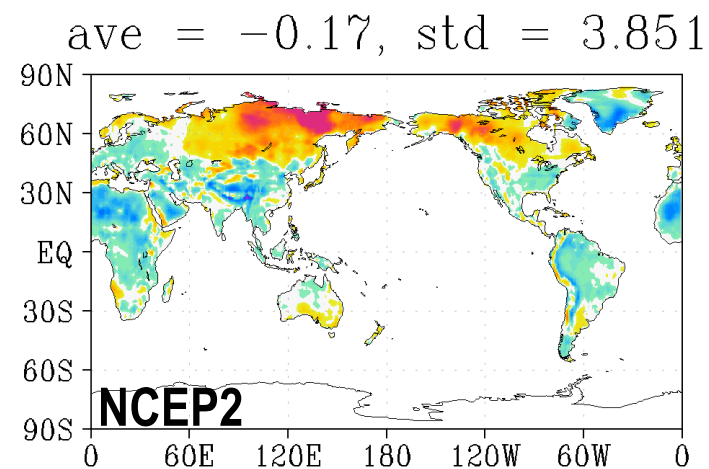
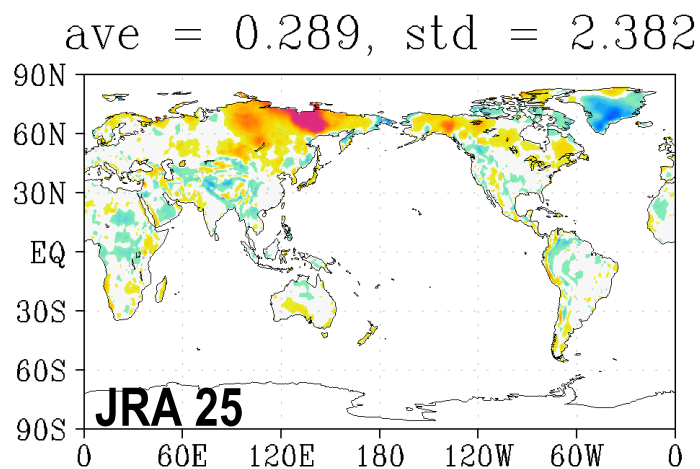
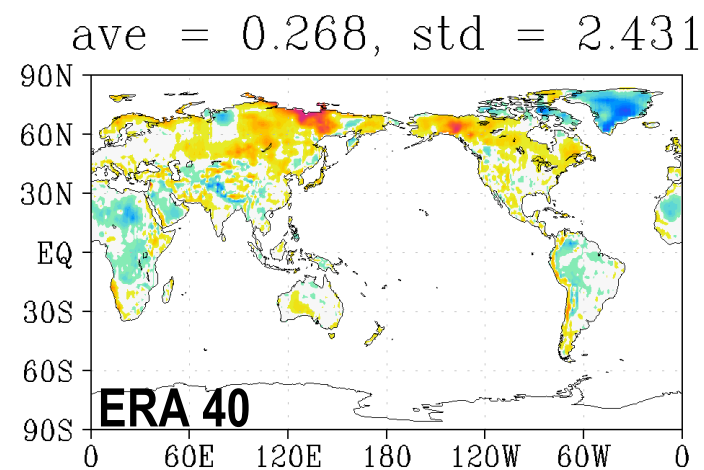
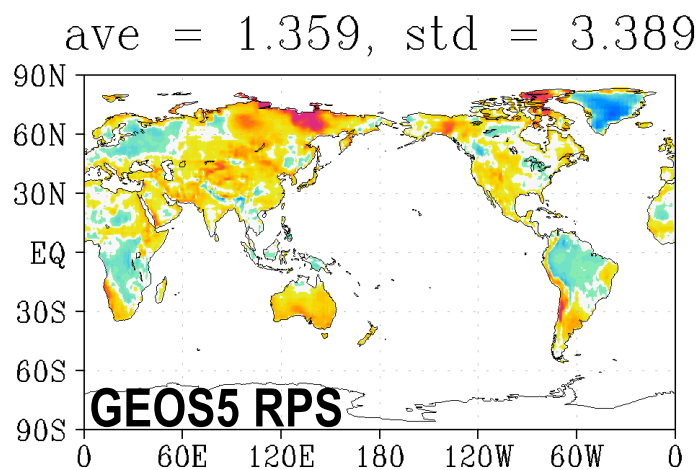


Jan. 2001 Specific Humidity – NVAP (g/kg)

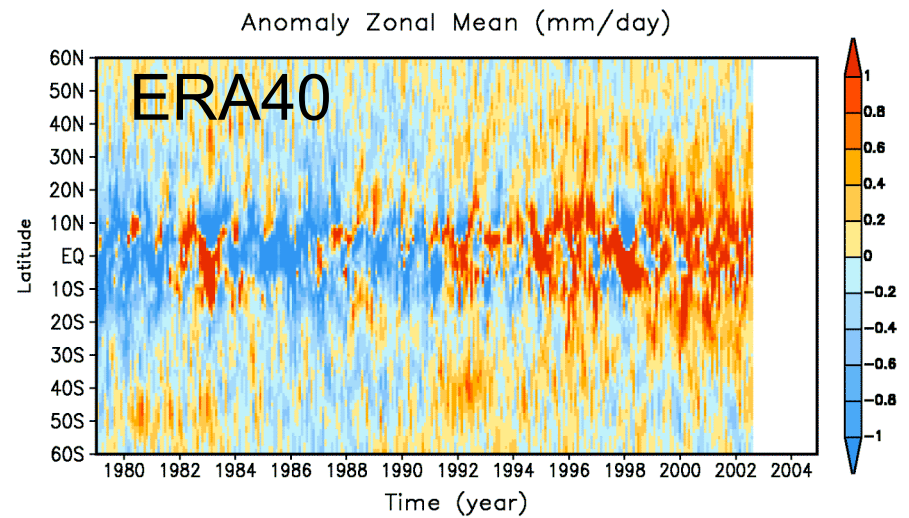
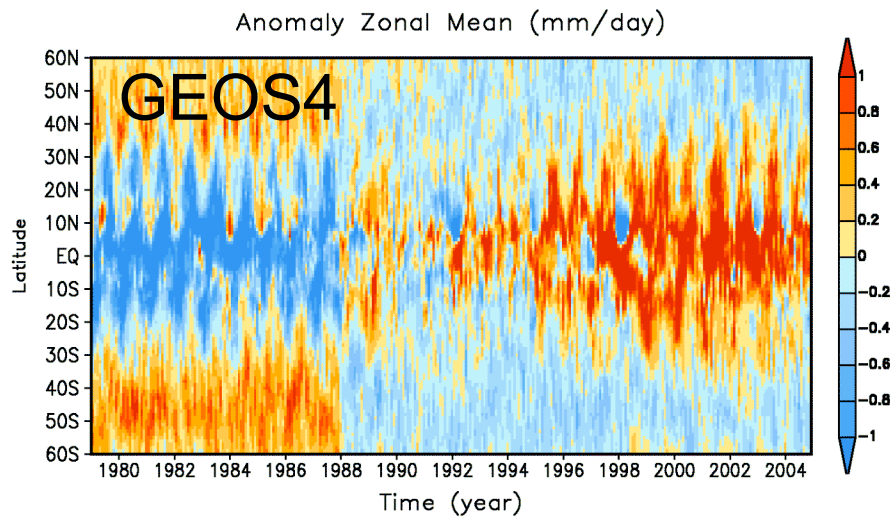
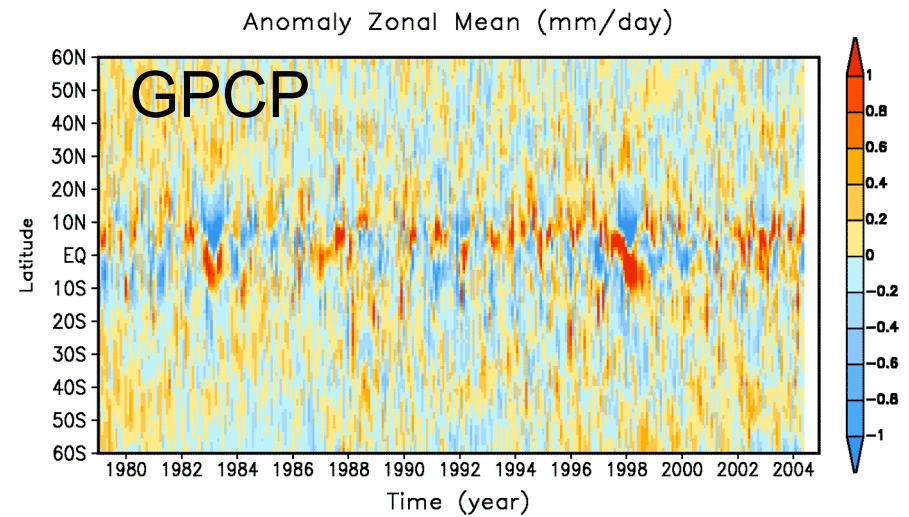
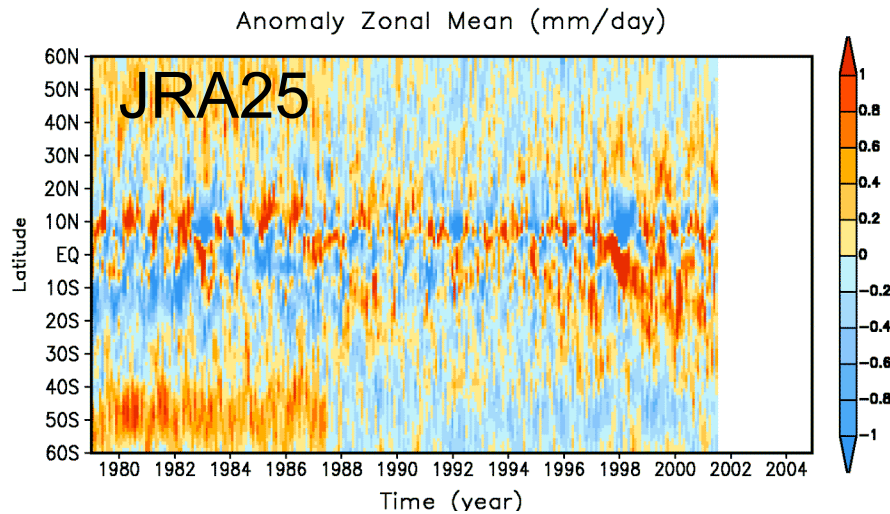


## 2° MERRA tests

January 2001 T2m - CRU (K)

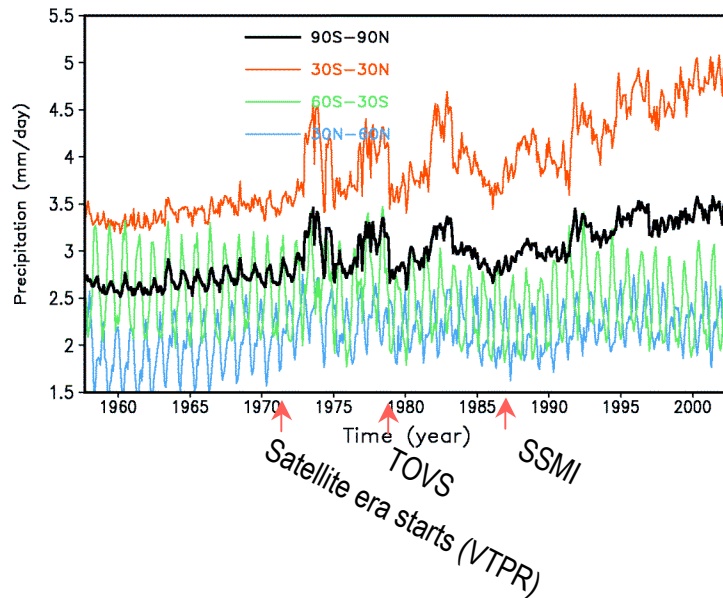


# Precipitation Trends



ERA-40

Precipitation

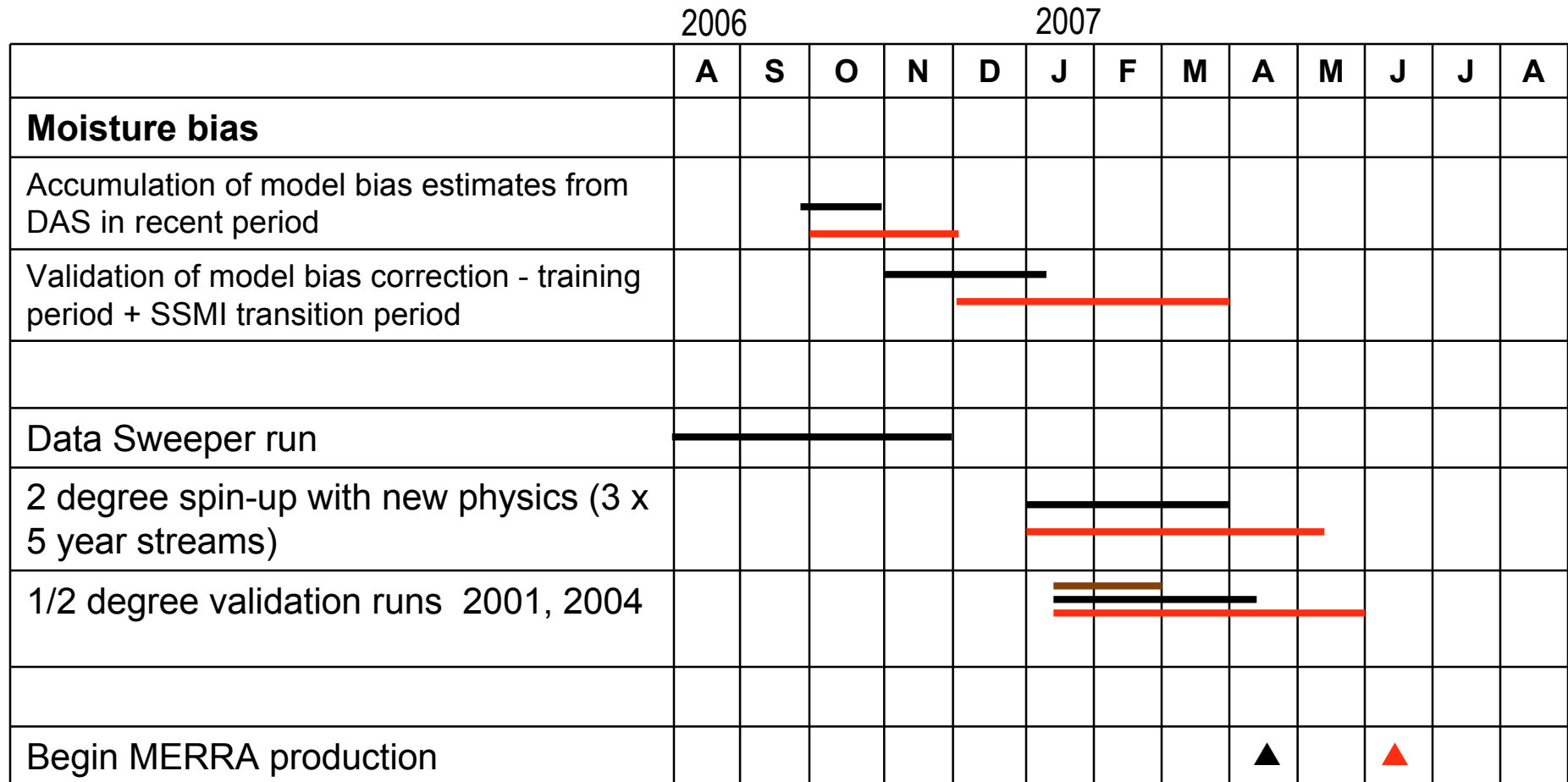


**Our goal for MERRA:** consistent moisture and precipitation throughout the re-analysis period

**Strategy** (based on suggestion from Kevin Trenberth): Correct the model moisture bias throughout the integration

- Methodology: Use online bias estimation from DAS to obtain diurnal and seasonal components of moisture bias correction for a recent multi-year assimilation (use 1 degree resolution).
- Validation: Repeat training period using fixed correction; test pre-SSM/I period.

# Schedule



 Expected duration of task

 Duration of task with unexpected delays (computer outages, other issues)

 4 seasons only for validation



## MERRA UPDATE: Issues for User Group

- Schedule
  - Goal is to start production in April 2007 which would imply completion spring 2009
- When do we stop developing?
  - Performance targets
  - Is delay for moisture bias correction worth it?
  - Decision points
    - mid-December: assess progress in bias correction
    - early January: 4-month vs 12-month validation decision



# Appendix

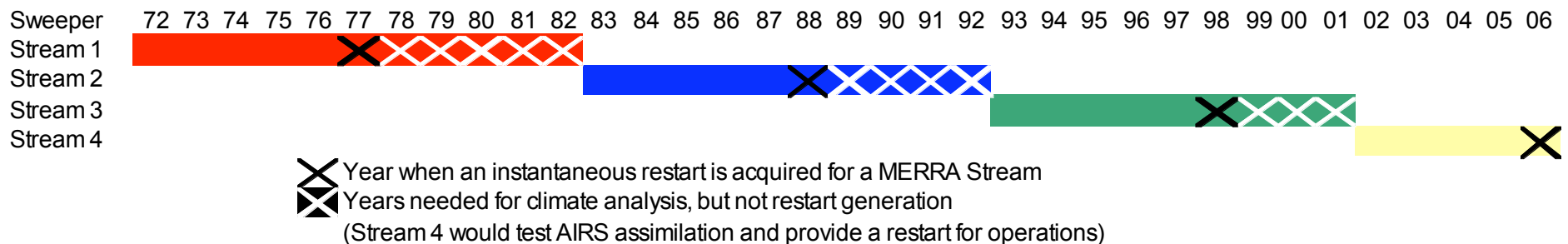
## Background slides

## Validation Strategy

- ✓ Pre-Sweeper tests on 3 periods (1998, 2001 and 2004) primarily for data
  - 2001: Re-Pre-Sweeper – includes IAU and Eros
- Sweeper – Science run, regular comparisons with existing reanalyses (ERA40, NCEP R2, JRA25 and GEOS4)
- Validation Experiments – 2001 & 2004
  - 1/2 degree, includes metrics for instrument team needs, forecast skills
  - 2004: Comparisons with operational analyses available via CEOP model output data archive

# Sweeper Execution

- Purpose: Exercise the data; Provide MERRA IC; Climate First-look
  - Currently a **Data Sweeper running**
- AMIP Climate simulation provides stream initialization 5 years upstream from the  $\frac{1}{2}$  degree start time
- Minimum 10-15 years of execution needed for  $\frac{1}{2}$  degree initialization



# MERRA Execution

- One year spin up at  $\frac{1}{2}$  degree from sweeper ICs
- Streams begin: Jan 1 – 1979, 1989 and 1999
- Along side MERRA
  - Reduced Observing System Baseline (ROSB) using conventional and TOVS data (low priority queue)
  - AMIP run

